SHARED WIRELINE CODE DIVISION MULTIPLE ACCESS

TECHNICAL FIELD

The invention relates generally to network communication and more particularly to use of shared network communication paths.

BACKGROUND

The number of network components attached to wireline networks is growing. Limited resources and space for physical connections between network components requires shared use of the wireline paths by the network components. The network components share the wireline path through employment of a communication protocol, for example, carrier sense multiple access / collision detection (CSMA/CD). The sharing of the wireline path limits the ability of the network components to both send and receive information based on transmission status of the shared wireline path. For example, the communication protocol allows only one network component to send a message over the wireline path at one time. When two or more network components attempt to send messages over the wireline path contemporaneously through employment of the CSMA/CD protocol, the messages collide and become unintelligible. After messages collide, the network components must wait for a period of time before attempting to re-send their messages. The period of time that the network components must wait reduces transmission efficiency of the wireline path.

Thus, a need exists for an increase in transmission throughput of messages between network components that use a shared wireline path. A further need exists for increased prevention of collision of messages between network components that use a shared wireline path.

SUMMARY

In one embodiment, there is provided a method for encoding a first message through employment of an outbound-message CDMA code to create an encoded outbound first message. The encoded outbound first message is sent over a single, shared wireline path and an encoded inbound second message is contemporaneously received over the single, shared wireline path. The encoded inbound second message is decoded through employment of an inbound-message CDMA code.

In another embodiment, there is provided an apparatus comprising a first network component coupled with one or more additional network components. The first network component sends a first message encoded through employment of a first CDMA code, of a plurality of CDMA codes, over a single, shared wireline path to one of the one or more additional network components and contemporaneously receives a second message encoded through employment of a second CDMA code, of the plurality of CDMA codes, over the single, shared wireline path from one of the one or more additional network components.

In yet another embodiment, there is provided an article comprising one or more computer-readable signal-bearing media. The article includes means in the one or more media for encoding a first message through employment of an outbound-message code division multiple access (CDMA) code to create an encoded outbound first message. The article includes means in the one or more media for sending the encoded outbound first message over a single, shared wireline path and contemporaneously receiving an encoded inbound second message over the single, shared wireline path. The article includes means in the one or more media for decoding the encoded inbound second message through employment of an inbound-message CDMA code.

DESCRIPTION OF THE DRAWING

Features of exemplary implementations of the invention will become apparent from the description, the claims, and the accompanying drawing in which:

FIG. 1 is a representation of one exemplary implementation of an apparatus that comprises one or more network components and a single, shared wireline path.

DETAILED DESCRIPTION

Turning to FIG. 1, an apparatus 100 in one example comprises one or more network components 102, 104 and 106 and a single, shared wireline path 110. The network components 102, 104 and 106 in one example comprise personal computers, workstations, and network servers. In a further example, the network components 102, 104 and 106 comprise an instance of a recordable data storage medium 112. The network components 102, 104 and 106 in one example are connected in a wireline local area network ("LAN") through employment of the single, shared wireline path 110. For example, the network components 102, 104 and 106 communicate with one another over the single, shared wireline path 110.

The network components 102, 104 and 106 comply with a code division multiple access ("CDMA") protocol to communicate over the single, shared wireline path 110. The network components 102, 104 and 106 comprise a network interface (not shown) to the single, shared wireline path 110 that can contemporaneously both send and receive data, for example, one or more messages, over the single, shared wireline path 110. In one example, the network components 102, 104 and 106 can simultaneously send and receive the messages. The network components 102, 104 and 106 employ a plurality of CDMA codes to communicate over the single, shared wireline path 110.

The network components 102, 104 and 106 prevent collisions of messages through employment of the plurality of CDMA codes, which allows for a higher transmission efficiency over the single, shared wireline path 110. The network component 102 employs a first CDMA code, for example, an outbound-message CDMA code, to send a first message over the single, shared wireline path 110 and a second CDMA code, for example, an inbound-message CDMA code, to contemporaneously receive a second message over the single, shared wireline path 110. For example, the network component 102 encodes the first message for the network component 104 through employment of a first CDMA code. The network component 102 sends the first message over the single, shared wireline path 110 to the network component 104 and contemporaneously receives the second message over the single, shared wireline path 110. The network component 104 receives and decodes the first message through employment of the first CDMA code. The network component 102 receives and decodes the second message through employment of a second CDMA code, as will be appreciated by those skilled in the art.

The network component 102 in another example employs a first CDMA code and a second CDMA code to contemporaneously send a first message and a second message. For example, the network component 102 encodes the first message through employment of the first CDMA code and encodes the second message through employment of the second CDMA code. The network component 102 sends the first message to the network component 104 and contemporaneously sends the second message to the network component 106. Through employment of the first CDMA code and the second CDMA code, the network component 102 can send the first message and the second message contemporaneously without causing collisions, in contrast to a previous design that suffered a shortcoming of reduced throughput upon a collision.

In yet another example, the network component 102 employs a first CDMA code and a second CDMA code to contemporaneously receive a first message and a second message. For example, the network component 104 encodes the first message through employment of the first CDMA code. The network component 106 encodes the second message through employment of the second CDMA code. The network components 104 and 106 contemporaneously send the first message and the second message to the network component 102. The network component 102 decodes the first message through employment of the first CDMA code and decodes the second message through employment of the second CDMA code. The network components 104 and 106 prevent a collision of the first message and the second message by encoding and decoding the first and second messages through employment of the first and second CDMA codes, as will be appreciated by those skilled in the art.

The plurality of CDMA codes in one example comprise one or more control CDMA codes. The network components 102, 104 and 106 in one example send one or more control messages over the single, shared wireline path 110. The network components 102, 104 and 106 encode the control messages through employment of the control CDMA codes. In one example, the network component 102 manages the single, shared wireline path 110 through employment of the control CDMA messages. In a further example, the network component 102 manages allocation of the plurality of CDMA codes through employment of the control CDMA messages.

The network components 102, 104 and 106 in one example comprise a plurality of sending and receiving pairs that are unique. For example, the sending and receiving pairs comprise the network components 102 and 104, the network components 102 and 106, and the network components 104 and 106. Where the sending and receiving pair both send and receive, two CDMA codes are needed. For example, the network component 102 employs a

first CDMA code when sending to the network component 104, and a second CDMA code when receiving from the network component 104. Where the first CDMA code and the second CDMA code are different, the network components 102 and 104 can send and receive messages contemporaneously. Where the other sending and receiving pairs employ different CDMA codes, all of the network components 102, 104 and 106 can send and receive between one another contemporaneously, as will be appreciated by those skilled in the art.

In one example, the one or more network components comprise a number N network components. The plurality of CDMA codes comprise a number $N^2 - N$ CDMA codes. The N network components communicate with one another through employment of the $N^2 - N$ CDMA codes such that a pair of the N network components employs two CDMA codes to send and receive between one another contemporaneously.

The single, shared wireline path 110 in one example comprises a coaxial cable, twisted pair cable, or optical fiber. The single, shared wireline path 110 electronically couples the network components 102, 104 and 106. The single, shared wireline path 110 in one example comprises a plurality of wireline paths, for example, wireline paths 114 and 116, that are electronically coupled by one or more network components 118, for example, network repeaters. The network component 118 in one example comprises a network switch, hub, router, or computer component with a plurality of network interfaces, as will be appreciated by those skilled in the art.

An illustrative description of exemplary operation of the apparatus 100 is presented, for explanatory purposes. The network components 102, 104 and 106 employ a plurality of CDMA codes to communicate with one another, for example, the network components 102, 104 and 106 send one or more messages over the single, shared wireline path 110. The plurality of CDMA codes comprise a first CDMA code, a second CDMA code, and a third CDMA code.

The network component 102 sends a first message over the single, shared wireline path 110 to the network component 104 through employment of the first CDMA code. The network component 102 receives a second message over the single, shared wireline path 110 from the network component 106 through employment of the second CDMA code. The network component 104 receives the first message over the single, shared wireline path 110 through employment of the first CDMA code. The network component 104 sends a third message over the single, shared wireline path 110 to the network component 106 through employment of the third CDMA code. The network component 106 sends the second message over the single, shared wireline path 110 to the network component 102 through employment of the second CDMA code. The network component 106 receives the third message over the single, shared wireline path 110 from the network component 104 through employment of the third CDMA code.

The network components 102, 104 and 106 in one example replace one or more of the plurality of CDMA codes, for example, to increase communication security of the messages or to change configurations of the wireline local area network. The plurality of CDMA codes in one example comprise a fourth CDMA code, a fifth CDMA code, and a sixth CDMA code, for example, replacement CDMA codes. The network components 102, 104 and 106 create fourth, fifth, and sixth messages that comprise the fourth CDMA code, the fifth CDMA code, and the sixth CDMA code, respectively.

The network component 102 sends the fourth message to the network component 104. The network component 104 replaces the first CDMA code with the fourth CDMA code. The network component 104 sends the fifth message to the network component 106. The network component 106 replaces the third CDMA code with the fifth CDMA code. The network component 106 sends the sixth message to the network component 102. The network component 102 replaces the second CDMA code with the sixth CDMA code.

In one example, the network component 102 sends a seventh message to the network component 104 through employment of the fourth CDMA code. The network component 104 sends an eighth message to the network component 106 through employment of the fifth CDMA code. The network component 106 sends a ninth message to the network component 102 through employment of the sixth CDMA code.

The network components 102, 104 and 106 in one example reuse one or more of the plurality of CDMA codes. For example, the network components 102, 104 and 106 create the fourth, fifth, and sixth messages that comprise the third CDMA code, the second CDMA code, and the first CDMA code, respectively. The network component 102 replaces the second CDMA code with the first CDMA code. The network component 104 replaces the first CDMA code with the third CDMA code. The network component 106 replaces the third CDMA code with the second CDMA code.

The network components 102, 104 and 106 in one example replace the first, second, and third CDMA codes at an end of a pre-determined time interval. For example, the network components 102, 104 and 106 employ the pre-determined time interval to promote synchronization between one another. A duration of the pre-determined time interval in one example comprises ten milliseconds. After the pre-determined time interval, the network components 102, 104 and 106 send the seventh, eighth, and ninth messages, as will be appreciated by those skilled in the art.

In another implementation, the network components 102 and 104 communicate through employment of the plurality of CDMA codes. The plurality of CDMA codes comprise a first CDMA code and a second CDMA code. The network component 102 sends a first message over the single, shared wireline path 110 to the network component 104 through employment of the first CDMA code. The network component 104 sends a second

message over the single, shared wireline path 110 to the network component 102 through employment of the second CDMA code.

The network components 102 and 104 in one example replace one or more of the plurality of CDMA codes. In one example, the plurality of CDMA codes comprise a third CDMA code and a fourth CDMA code. The network component 102 sends a third message that comprises the third CDMA code to the network component 104. The network component 102 sends the third message to the network component 104 to replace the first CDMA code. The network component 102 receives a fourth message that comprises the fourth CDMA code from the network component 104. The network component 102 replaces the second CDMA code with the fourth CDMA code.

In one example, the network component 102 sends the third message to the network component 104 at an end of a pre-determined time interval. The network component 104 sends the fourth message to the network component 102 at the end of the pre-determined time interval. After the pre-determined time interval, the network component 102 sends a fifth message to the network component 104 through employment of the third CDMA code. The network component 104 also sends a sixth message to the network component 102 after the pre-determined time interval through employment of the fourth CDMA code.

The apparatus 100 in one example comprises a plurality of components such as one or more of electronic components, hardware components, and computer software components. A number of such components can be combined or divided in the apparatus 100. An exemplary component of the apparatus 100 employs and/or comprises a set and/or series of computer instructions written in or implemented with any of a number of programming languages, as will be appreciated by those skilled in the art.

The apparatus 100 in one example employs one or more computer-readable signal-bearing media. Examples of a computer-readable signal-bearing medium for the

apparatus 100 comprise the recordable data storage mediums 112 of the network components 102, 104 and 106. For example, the computer-readable signal-bearing medium for the apparatus 100 comprises one or more of a magnetic, electrical, optical, biological, and atomic data storage medium. In one example, the computer-readable signal-bearing medium comprises a modulated carrier signal transmitted over a network comprising or coupled with the apparatus 100, for instance, one or more of a telephone network, a local area network ("LAN"), the internet, and a wireless network.

The steps or operations described herein are just exemplary. There may be many variations to these steps or operations without departing from the spirit of the invention. For instance, the steps may be performed in a differing order, or steps may be added, deleted, or modified.

Although exemplary implementations of the invention have been depicted and described in detail herein, it will be apparent to those skilled in the relevant art that various modifications, additions, substitutions, and the like can be made without departing from the spirit of the invention and these are therefore considered to be within the scope of the invention as defined in the following claims.